

REMARKS

Claims 1 and 4-7 are pending in this application; and in the Office Action, the Examiner issued a final rejection of these claims under 35 U.S.C. 103 as being unpatentable over the prior art discussed in this application in view of U.S. Patent 5,994,762 (Suwanai, et al.).

Applicants herein ask that independent Claim 1 be amended to better define the subject matter of the claims.

For the reasons discussed below, Claims 1 and 4-7 patentably distinguish over the prior art and are allowable. The Examiner is, thus, asked to enter this Amendment, to reconsider and to withdraw the rejection of Claims 1 and 4-7, and to allow these claims. More specifically, Claims 1 and 4-7 patentably distinguish over the prior art because the prior art does not disclose or suggest the feature, described in independent Claims 1 and 7, that the trench, void or groove of the crack stop extends substantially completely between the top layer and the bottom substrate of the IC chip.

To better understand this, Applicants believe it may be helpful to discuss briefly the prior art and the present invention.

The prior art described in this application, and shown in Figure 1, has a metal crack stop, which extends around a moisture barrier region. This technology, however, is not completely satisfactory. In particular, cracks formed during a dicing operation stop at the crack stop, but this exposes the copper in the metal stack to water vapor, causing rapid oxidation of the copper. This, in turn, causes exposure of the copper in the moisture barrier, which allows moisture to enter the chip, which can lead to chip failure.

In rejecting the claims, the Examiner argued that, with the prior art disclosed in the application, "the copper metal interconnects 18...do not form a self-passivating oxide layer." Applicants respectfully disagree. As explained in the specification in paragraph 17, the interconnects of the prior art arrangement are oxidized as a result of the cracks formed in the chip. In fact, an objective of the present invention is to eliminate this oxidization.

The present invention effectively addresses this problem by forming the crack stop as a trench or void. As shown in Figure 2, this trench or void extends substantially completely between the top aluminum layer and the bottom substrate of the IC.

Suwanai discloses the use of a slit, disposed between a guard ring and the periphery of the IC chip, to inhibit intrusion of cracks formed in the boundary of the chip.

There are, however, a number of important features of the invention that are not shown or suggested by the prior art discussed in this application or by Suwanai.

For instance, in Suwanai, Crack stop "S" stops in the BPSG (the layer under layer 28); cracks may be able to propagate through Crack stop "S" stops in the BPSG (the layer under layer 28); cracks may be able to propagate through the BPSG into the chip. The present invention forms a crack stop through the BPSG.

The crack stop "S" is not self-aligned to the guard ring "GR". If you compare the left and right sides of the chip, the spacing between S and GR will be different, because Suwanai uses an extra mask to form S. With the preferred embodiment of the present invention, the same mask is used to form S and GR, so the spacing between them is the same on both sides of the chip (i.e. S and GR are self-aligned).

Suwanai form S using an extra mask and dielectric etch. In the present invention, preferably, S is formed by forming a metal filled stack (Cu and W) and leaving it uncovered

with the final Al layer and then using a wet etch to remove metals.


Independent Claims 1 and 7, as amended herein, describes the feature that the trench, void or groove of the crack stop extends substantially completely between the bottom substrate and the top aluminum layer of the IC chip. As mentioned above, this feature is important because it helps to prevent the migration of the cracks to the water seal. In particular, compared to the arrangement shown in Suwanai, the present invention prevents the propagation of cracks through the BPSB into the chip.

Because of the above-discussed differences between Claims 1 and 7 and the prior art, and because of the advantages associated with those differences, Claims 1 and 7 patentably distinguish over the prior art. Claims 4-6 are dependent from Claim 1 and are allowable therewith. The Examiner is, thus, asked to reconsider and to withdraw the rejection of Claims 1 and 4-7 under 35 U.S.C. 103, and to allow these claims.

The changes to the claims being made herein only elaborate on features already described in the claims. For example, Claims 1 and 7 presently describe an IC chip and describe the crack stop as formed by at least one trench, void, or groove. The amendments herein indicate that the IC chip includes a bottom substrate, and describe the extent of the trench, void or groove of the crack stop. It is thus believed that entry of this Amendment is appropriate, and such entry is respectfully requested.

For the reasons set forth above, the Examiner is asked to enter this Amendment, to reconsider and to withdraw the rejection of Claims 1 and 4-7 under 35 U.S.C. 103, and to allow these claims. If the Examiner believes that a telephone conference with Applicants' Attorneys would be advantageous to the disposition of this case, the Examiner is requested to telephone the undersigned.

Respectfully submitted,


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